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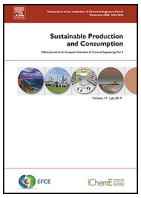

Effects of sustainable supply chain integration on green innovation and firm performance

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ABSTRACT

Sustainability has a well-established influence on innovation, but less scrutiny about the efficacy of sustainable supply chain integration as a determinant of green innovations has been done. Based on information processing theory and dynamic capability view, this study proposes a framework relating sustainable supply chain integration, green innovation, and firm performance. Primary survey data and secondary data of annual reports published by 296 manufacturing firms from 19 different sectors in Pakistan were collected, and structural equation modeling (AMOS 26 and SPSS 25) was employed. Results indicate that sustainable internal, supplier, and customer integration foster both green managerial and process innovations. Findings also suggest that green managerial innovation has a significant positive influence on the firm's financial performance. In contrast, the influence of green process innovations on firm performance is negatively significant, suggesting that rapid changes in manufacturing processes and operational procedures cost firms in multiple ways and decrease firms' profits. The new findings have implications for both managers and researchers in managing sustainable supply chains and green innovation .

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1. Introduction

A sustainable supply chain (SSC) refers to the inter- and intra-organisational practices in supply chains related to environmental problems (Taghikhah et al., 2019), which fulfill the chucks of environmental protection all along the supply chains (Han and Huo, 2020). Practicing sustainability in supply chains enables firms to innovate, utilize their resources, capabilities, productivity, and focus on their customers while maintaining given environmental aspects (Afum et al., 2020). Eco-friendly investments take firms away from competition, thereby creating a competitive advantage (Wong et al., 2020). Sustainable supply chain management (SSCM) suggests that when firms become sustainable, their operations become different from traditional supply chains and obtain more market opportunities (Afum et al., 2020; Aisjah and Prabandari, 2021) . Companies are encouraging their supplies to practice International Organization for Standardization (ISO) standards such as ISO 14,000/14,001. Sustainable firms not only think about economic gains; instead, they believe in triple bottom line (TBL) concepts, which are about environmental, social, and economic aspects (Burki et al., 2019; Wong et al., 2020).

Although sustainable supply chains are different from traditional ones, still they need unification of the firm's capabilities, competencies, skills, and resources within the organization and among all supply chain partners to increase innovation and enhance firm performance (Zhao et al., 2008; Han and Huo, 2020). Supply chain integration (SCI) is a concept that suggests that firms integrate with supply-side and demand-side supply chain partners. Although previous literature has focused on SCI, there is less emphasis on sustainable supply chain integration (SSCI). According to Syed et al. (2019), SSCI is:

> "collaboration and coordination among all partners in the supply chain for the mutually sustainable practices inside and outside the organization, which comprise of three dimensions such as internal, supplier and customer integration."

The definition presented by Syed et al. (2019) differentiates SSCI from SCI. SCI refers to the integration of a firm's resources and information among all supply chain partners, whereas SSCI refers to the collaboration among supply chain partners for mutually sustainable practices (Afum et al., 2020;Zhang and Cao, 2018). There are two significant categories for SSCI: external and internal SSCI. Internal SSCI refers to the enhancing capabilities of the firm by re-

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moving barriers and motivating employees to learn initiatives related to environmental issues (Syed et al., 2019; Wong et al., 2020). Alternatively, external SSCI refers to the collaboration amongst the firm's customers and suppliers to resolve issues related to the environment (Aisjah and Prabandari, 2021). SSCI encourages supply chain partners to cooperate in eradicating the harmful effect of their business and operational activities on the environment (Zhu et al., 2017). Internal, customer, and supplier integration is proven as a helpful tool in increasing the performance of the firms (Afshan and Motwani, 2018; Aisjah and Prabandari, 2021). Therefore, each integration type describes the importance of different facets of SSCI, and this is also a prerequisite to examining the effects of each kind (Afum et al., 2020; Aisjah and Prabandari, 2021) on green innovation (Yang et al., 2018; Singh et al., 2020) and firm financial performance.

When firms collaborate and integrate their resources with supply chain partners, their chances of innovation increase. Sustainable firms focus on sustainable practices, and they use a term of green innovation, which is mostly interchangeable with different terms such as eco-innovation, environmental innovation, environmentally friendly innovation, but the context is the same (Afum et al., 2020). Green innovation (GI) advocates the innovations in the firm's process, operational and organisational structure, services, and managerial concerns towards the elimination of environmental pollution such as waste and excess use of energy and fuel (Sinnandavar et al., 2018; Sellitto et al., 2020).

According to the "National Policy on Solid Waste Management (NPSWM) Pakistan", all the manufacturing firms are required to take severe responsibilities concerning the effects of their products on the environment. Green innovation helps reduce industrial waste, reduces operational cost, enhances efficiency, and improves the firm financial performance (Singh et al., 2020; Wong et al., 2020). Literature is mixed, e.g., some are not up to date while others are not specific to the region like Pakistan, either conducted in western developed countries or eastern Asia. The results do not apply to Pakistan due to different institutional settings, behavioral peculiarities, and socioeconomic settings. A study addressing Pakistan is needed because it is ranked number 8 among affected countries due to pollution and climate change (Eckstein et al., 2021). One of the significant contributors to pollution in Pakistan is manufacturing waste and emission Hammarskjöld (2020). This study focuses on the manufacturing industry in Pakistan to answer the following questions. To what extent does sustainable supply chain integration foster green innovation in manufacturing firms of Pakistan? Does green innovation reduce cost, increase efficiency, and help grow manufacturing firms' financial performance in Pakistan?

This study collects 296 useable responses from the manufacturing firms and uses SPSS 25 and AMOS 26 for factor analysis and structural equation modeling (SEM). This study provides a different viewpoint of SSCI and green innovation. To the author's knowledge, this is the first study that describes SSCI as an information processing tool that helps firms get and process the exact amount of information timely from all sides of the supply chain, and green innovation as dynamic capability of the firm, which reduces firms cost, provides a competitive advantage, enhances efficiency, and improves firms' financial performance.

The article is structured as follows: The second section offers the literature review and develops hypotheses. The third section provides the method. Section fourth and fifth provides results and discussion. The last section presents the conclusions.

2. Literature review

This section discusses the background of the constructs taken in our research such as SSCI, GI, and FFP. After a detailed discussion of the constructs concerning literature, hypotheses are developed and a conceptual framework is presented.

2.1. Theoretical background

To reinforce the main capabilities of sustainable development, the capacity perspective and natural resource-based view (NRBV) advocates the synchronization of internal organisational processes and all supply chain partners towards effective eco-friendly practices (Demeter et al., 2016; Lee et al., 2016; Afum et al., 2020) but less scrutiny of information processing theory (IPT) and dynamic capability view (DCV) is done. Integration practices (i.e., internal, supplier and customer) refer to sharing knowledge, cooperation on environment protection, and joint development, which increases firms' level of information sharing and is in accordance with IPT. Therefore, when the firm's level of information sharing increases, it enhances the firm's green innovation capabilities (Wong et al., 2020). The focus of the firm's management about implementing internal integration practices is due to its attributes of continuous learning, which ultimately increase the firm's information sharing capabilities and enhance green innovations (Shi et al., 2012; Wong et al., 2020). Adherence to green innovation practices throughout the supply chain enhances a firm's ability to cope with environmental issues (Hu et al., 2017; Katiyar et al., 2018; Khan et al., 2017). Green innovations reduce the firm's cost of handling environmental waste, increasing firm performance (Burki et al., 2018; Wong et al., 2020).

Although the previous literature explains the concepts and explores the relationship between them, they lack in many ways, which needs further investigation. First, existing studies (e.g., Burki et al., 2018; Singh et al., 2020; Afum et al., 2020) focus on linking the relationships through NRBV and transaction cost theory (TCT). However, their theoretical perspective is good but old. There is a need to investigate the relationships through theories that represent them more clearly, such as IPT and DCV. Second, existing studies on previous literature represent the Western or East Asian point of view, which might not be implementable to the South-Asian firms due to differences in behavioural and operational peculiarities. Third, the existing literature is unclear about which integration practice significantly affects green innovation and performance. Therefore, the current literature leaves a gap behind and this study aims at filling that gap.

2.2. Sustainable supply chain

Recently the concept of sustainable supply chain management has emerged and become an essential part of supply chain management literature. Previous literature suggests that sustainable firms' operations are different from traditional firms (Ahi and Searcy 2013; Syed et al., 2019). According to Ahi and Searcy 2013, the sustainable supply chain is:

> "The creation of coordinated supply chains through the voluntary integration of social, environmental, and economic considerations with key inter-organisational business systems designed to effectively and efficiently manage the capital, information, and material flows associated with the production, procurement, and distribution of services and products, or in order to improve the resilience of the organization over the long and short-term and increase the profitability and competitiveness and meet stakeholder requirements."

Therefore, SSC has a competitive advantage over the traditional supply chain and they perform well in environmental, social, and financial directions (Pagell and Wu, 2009). However, to achieve sustainability, supply chains must comply with measures and practices, which are the pillars of sustainability. Suppose any of these is not fully adapted, and firms fail in measuring and controlling. In that case, the supply chain is not fully sustainable and will face the resulting ambiguity and risks (Silvestre et al., 2014). Thus, sustainable firms must cooperate and integrate with supply chain partners to achieve sustainability (Syed et al., 2019). John Elkington coined the term sustainability pillars in 1998, which is also famous as the triple bottom line. These pillars have got much attention due to their importance and applicability. The three pillars of TBL are social, economic, and environmental, and they have gained much attention due to their significance and applicability (Burki et al., 2018). The environmental side of TBL deals with non-renewable energy, deposits in landfills, and reducing all kinds of processes that release carbon footprints and provide harm to the natural environment. Due to this, firms are going green and they adopt the approach which encourages resale, reuse, recycle and remake (Rostamzadeh et al., 2018). The economic side of TBL enables the firm to be responsible for environmental impacts while focusing on the economic side. Firms are encouraged to align their economic and environmental concerns (Burki et al., 2019). Alternatively, handling social issues such as employee relationships, equality, gender diversity, wage rate selection, and ethical code of conduct is known as the social side of TBL Buddress (2013).

The above discussion indicates that SSC is different from the traditional supply chain and their operations, procedures, and ways of doing business are not the same. Therefore, sustainable firms practicing TBL have different goals from the traditional supply chain. Primarily, they focus on 4Rs (i.e., reduce, reuse, recycle and remake), which need sustainable integration among all players in the whole supply chain to achieve the opportunity to innovate their managerial and production processes, which can lead them to higher firm performance. But regarding previous literature, there is little research on SSC generally, and no study has tried to identify the combined impact of SSCI, GI, and FFP. Therefore, this paper deals with SSCI, GI, and FFP. These three concepts are discussed in detail in the next segment.

2.3. Sustainable supply chain integration

Firms practicing sustainability develop competitive advantage through different operations, structures of the business, and product development Wolf (2011). Apart from the benefits of being a sustainable firm, they also face uncertainties in their supply chains, which need to be mitigated; otherwise, they have a severe impact on their level of innovation and performance (Burki et al., 2019). Therefore, they need an integrated system among all supply chain partners to cope with these uncertainties. Although the literature on supply chain integration (SCI) has contributed a lot to supply chain management, it is divergent and contradictory (Chang et al., 2016). The inconsistency in the previous literature has opened room for new researches as they haven't grasped a unified consent about SCI dimensions, directions, and definition (e.g., Lee and Whang 2001; Swink et al., 2007; Visser et al., 2008). The previous studies have explained the importance of SCI, but the detailed definition is presented by Zhao et al., 2008. According to them, SCI is:

> "the degree to which an organization strategically collaborates with its supply chain partners and manages intra and inter-organization processes in order to achieve effective and efficient flows of products and services, information, money, and decisions with the objective of providing the maximum value to the customer at low cost and high speed" (Zhao et al., 2008, p. 374).

SCI states information sharing at all levels among partners in the supply chain (Leuschner et al., 2013). SCI is mutual processes, joint activities, and collaborative procedures among supply chain partners (Saeed et al., 2005; Ireland and Webb, 2007; Cao and Zhang, 2011). SCI is different according to its dimensions and usability, such as information integration (Hill and Scudder 2002; Holweg et al., 2005) and relationship integration (Johnson 1999; Chen et al., 2004). SCI also has broader dimensions such as internal integration and external integration (Zhao et al., 2008). Internal integration is about firms' internal processes, structures, strategies, and collaborative processes through which they interact within the organization to fulfill their customers' requirements (Flynn et al., 2010). In contrast, external integration is grouped into two classes of customers and suppliers. External integration deals with the partners in the whole supply chain for making synchronised processes and strategies (Flynn et al., 2010). Alternatively, supplier integration deals with sharing information among suppliers and mutual manufacturing activities while customer integration deals with sharing information and collaboration with the customers to improve product designs, after-sales services and achieve customer satisfaction (Zhao et al., 2008).

Moreover, the focus of previous literature on the supply chain has just focused on SCI, but SCI in terms of sustainability is ignored. Syed et al. (2019) investigated the relationship between sustainable supply chain risk and SSCI, in which they have differentiated SSCI from SCI. According to their definition:

> "SSCI is collaboration and coordination among all partners in the supply chain for the mutually sustainable practices inside and outside the organization, which comprise of three dimensions such as internal, supplier and customer integration" (Syed et al., 2019).

SSCI demands that the companies and their all-supply chain partners should work toward the same objective. For aligning the work towards the same objectives, it is necessary to share resources and information and establish a risk and reward structure (Soosay et al., 2008). SSCI can be attached to the natural resource-based view, which is a well-known theory about sustainable practices. Hart (1995) emphasized that with applications of the natural resource-based view, firms can create sustainable core competencies, e.g. while planning and making strategical decisions, firms must consider sustainability issues. This improves the company's abilities to tackle the ecological risks, and in return, the firm's financial performance increases (Shi et al., 2012). Likewise, product stewardship was introduced to cope with the cross-organisational environmental problems, which are the reasons behind major issues disturbing firms' internal processes. Product stewardship motivates supply chain partners at the supply-side and customer side to collaborate mutually (Vachon and Klassen, 2008). These practices advocate the importance of supplier, internal, and customer integration.

2.4. Green innovation

Recently, green innovation has been of serious attention, and the term is often interchanged with different terms in literature such as environmental, ecological, and sustainable innovation. Researchers have defined these terms according to their concept of applicability, e.g., Oltra and Saint Jean (2009) defined environmental innovation "as innovations that consist of new or modified processes, practices, systems, and products which benefit the environment and contribute to environmental sustainability." Graczyk et al. (2018) defined ecological innovations as "enterprises that generate a triad of social, economic and environmental benefits" or "new products and processes which provide customer and business value but significantly decrease environmental impacts." Berkowitz (2018) described sustainable innovation as "socially desirable outcomes meeting the needs of the present without compromising the ability of future generations to meet their own needs and innovation that meets this condition is considered sustainable.” Finally, the comprehensive definition of green innovation is presented by Chen et al. (2006) who defined green innovation as “hardware or software innovation that is related to green products or processes, including the innovation in technologies that are involved in energy-saving, pollution-prevention, waste recycling, green product designs, or corporate environmental management.”

Apart from presenting definitions of green innovation, researchers have also focused on identifying the dimensions of green innovations. Green product innovation and green process innovation are frequently cited as the dimensions of green innovation (Achi et al., 2022; Huang and Chen, 2022). Green product innovation is defined as “innovation that leads to design, manufacturing, and marketing of the product with no or insignificant effect on human and environment throughout its life phase, and outperform the conventional commonly used competing for alternatives” (Wagner, 2010). On the other hand, green process innovation is defined as “advancement in technologies and processes that result in the manufacturing of goods with no or less environmental impact” (Chen, 2008). Researchers have tried to check the impact of green product and process innovation on the economic and environmental performance of the firm, but the results are contradictory and need more research for clarification (Afum et al., 2020; Wong et al., 2020; Aisjah and Prabandari, 2021). Recently a new concept of green managerial innovation (Tseng et al. 2013; Burki et al., 2018) is emerged in literature, which is considered a new dimension of green innovation. To comply with environmental policies, managers tend to change their ways of managing firms, and this process is known as green managerial innovation (Burki et al., 2018). Alternatively, green process innovation is associated with utilizing a firm’s resources in such ways; environmental damage should be reduced while production (Xie et al., 2019; Sellitto et al., 2020; Wang et al., 2021).

This study focuses on green managerial and green process innovation because the impact of these dimensions on the firm’s performance is contradictory in the literature. Green product innovation is not included since not every firm can fulfill it due to the nature of its product (Huang and Chen, 2022). For example, an automobile company can advance its technology and make greener products, but the same can’t be implemented in the glass industry or leather industry. That was the reason that green product innovation is not included in this study because our research focuses on all manufacturing industries. The literature review revealed that for the adoption of green innovation, it is important that firms collaborate, transfer knowledge, share information, and develop a networking channel with their external partners (Quist and Tukker, 2013). Firms whose external network is more efficient tend to have more active green innovation (Cai and Zhou, 2014). Collaborating with the partners in the supply chain increases the flow of information and passes the knowledge from one party to another, which increases the capabilities of solving technological problems, increase competency, and increases the chances of green innovation (Visser et al., 2008; Kleef and Roome, 2007; Floricel et al., 2008).

Although green innovations are affected by the integration practices among supply chain partners (Wong et al., 2020; Aisjah and Prabandari, 2021; Espino-Rodríguez and Taha, 2022), there has been no comprehensive survey conducted that measures the connections among green managerial innovation, green process innovation, and sustainable supply chain integration. Moreover, based on the DCV, green innovations are the dynamic capabilities for manufacturing firms, providing competitive advantages, cost savings, and more financial returns (Afum et al., 2020; Wong et al., 2020). Despite the importance of green innovation on FFP, no one has measured its impact by using the secondary data except Przychodzen and Przychodzen (2015), who characterised firms based on financial data of innovative and non-innovative companies. Their study is not enough and cannot be implemented in different countries with different behavioral and institutional peculiarities. Most of the researchers (Burki et al., 2019; Afum et al., 2020; Wong et al., 2020) have measured the impact of GI on FFP merely through survey data. Therefore, this research focuses on clarifying the doubts in literature, and the hypotheses are developed in the following part of the study.

2.5. Relationship between sustainable supply chain integration, green innovation, and firm financial performance

In response to the above-discussed gap in the literature, a theoretical model is established in this study which is illustrated in Fig. 1. The model measures the influence of SSCI on green innovation and firms’ financial performance.

2.5.1. Sustainable supply chain integration and green innovation

Sustainable practices are considered the critical drivers for green innovation, which aims to reduce the negative effects of the production process on the environment. Sustainable practices lead to better managerial and production methods for growing together in society. Sustainable firms not only think about their economic benefits but also focus on environmental and social aspects. Therefore, it can be said that SSCM is the basis for the foundation of green innovation (Afum et al., 2020; Aisjah and Prabandari, 2021; Huang and Chen, 2022). According to information processing theory, when a firm shares its resources, techniques, tools, and information with all supply chain partners, it reduces the uncertainties linked with green processing and green innovation and makes the process smooth (Wong et al., 2020).

Internal integration suggests the sharing of information among different departments and processes. To comply with green innovations, departments within a firm must coordinate with each other and remove barriers in communication and coordination among different departments (Wong et al., 2020). Green innovations are associated with a change in product design, manufacturing processes, and managerial decisions Wong (2012). The cooperation of top management is essential to adjust manufacturing processes. Senior and junior level managers should be conferred with while making decisions related to environmental concerns. A proper risk and reward system, goal setting, and employee participation increase the firm’s green innovation initiatives (Zhu et al., 2013). Firms can employ a proper environmental management system to create stability between firm environmental creativities and revenues through internal integration practices (Wong et al., 2020; Aisjah and Prabandari, 2021).

Green managerial innovations are directed to redesign the production system to alter ecological outcomes (Tseng et al., 2013). Firms need to change their production methodologies and their products to cut down the related environmental costs. Besides, decisions related to the certification of ISO 14,000/14,001 increase a firms’ environmental performance (Zhu et al., 2013). The above discussion concludes that when sustainable firms integrate their processes and information within the firm, chances of innovating increase, but in terms of SSCI, no previous study shows the linkage between sustainable internal integration (SII) and GI. Therefore, this study presents the following hypotheses:

H1a *Sustainable internal integration has a positive relationship with green managerial innovations*

H1b *Sustainable internal integration has a positive relationship with green process innovations*

Apart from internal integration, close collaboration and information sharing among suppliers result in collective developments

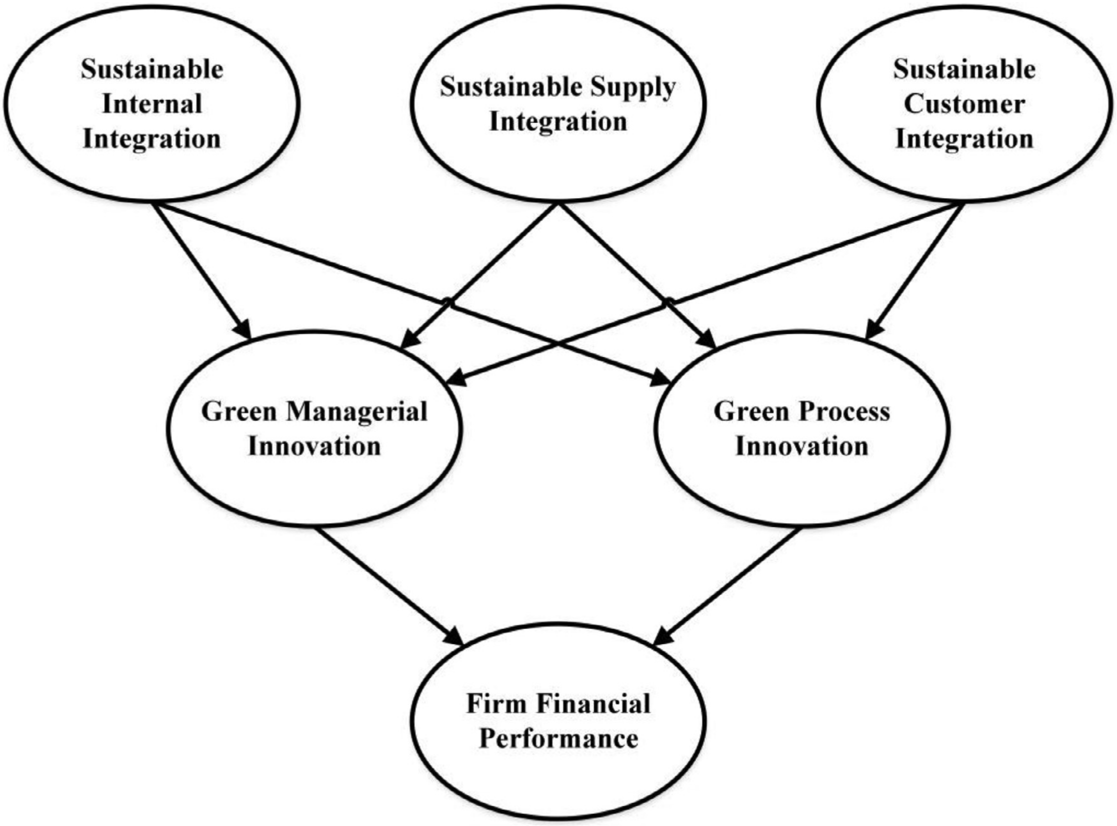
Sustainable Internal Integration
Sustainable Supply Integration
Sustainable Customer Integration
Green Managerial Innovation
Green Process Innovation
Firm Financial Performance

Fig. 1. Hypothesised research model.

and mutual trust (Syed et al., 2019). Sustainable supply integration (SSI) allows manufacturing firms and their suppliers to share information frequently, know each other better, reduce conflicts, and increase the level of green innovations (Lau et al., 2010). Thus, implementing SSI enables firms to proactively solve supply-related problems through knowledge sharing with critical suppliers, which are key drivers for green managerial and green process innovations (Burki et al., 2019; Wong et al., 2020). It involves exchanging knowledge about sustainable techniques, procedures, and sources of green material among supply chain partners to produce the products following environmental standards (Zhu et al., 2017). For example, firms like Walmart and Toyota encourage their suppliers to certify, practice, and adhere to the guidelines of ISO 14,000/14,001. Therefore, it can be said that SSI is used to be a driver for green innovation. Previous literature has developed less emphasis on it, and it is not clear empirically what direction SSI leads green innovation to. To check the impact of SSI on green innovation, we have developed the following hypotheses in this study:

H2a *Sustainable supply integration has a positive relationship with green managerial innovations*

H2b . *Sustainable supply integration has a positive relationship with green process innovations*

Sustainable customer integration (SCUI) is known as a “firm's collaboration and coordination with customers about the production process, demand, and aftersales service” (Syed et al., 2019). Therefore, coordinating with customers enables firms to know about the market demand, product specifications, and services their customer wants in sustainable products, which ultimately leads to process innovation (Wu, 2013; Wong et al., 2020). SCUI enables firms to develop their managerial process in a supportive way, and firms could achieve environmental goals with the help of their customers (de Carvalho and Barbieri, 2012. Sustainable firms encourage their logistics and shipping partners to adhere to the guideline of sustainable packaging and distribution (Wolf, 2011). Moreover, SCUI also leads firms towards higher environmental performance by sharing knowledge about the harmful impact of the product by the customer to the firm (Zhu et al., 2017). Although green innovation has many benefits to the firm, the important one is it enhances the firm's performance through cost savings of environmental waste, reduction in energy usage, and eliminating excess use of raw material (Syed et al., 2019). Despite the benefits of SCUI and its impact on the firm's green innovation, only a few studies have been conducted that measure their impact. They are few, and the findings are unclear, which cannot be generalised. Therefore, this study presents the following hypotheses:

H3a *Sustainable customer integration has a positive relationship with green managerial innovations*

H3b *Sustainable customer integration has a positive relationship with green process innovations*

2.5.2. Green innovations and firm financial performance

Green innovation practices enhance technical processes that boost firms' dynamic capabilities and increase environmental, economic/financial, and social performance (Burki et al., 2019). Changes in production processes and ways of management require that a firm measure its performance frequently to achieve its economic objectives. According to studies conducted by Verghese and Lewis (2007) and Shrivastava (1995), firms that are involved in managerial innovation have experienced a decrease in the cost of operations and production, leading to competitive advantage and increasing firms' financial returns (Zhu et al., 2013; Wong et al., 2020; Wang et al., 2021). Besides, when a company implements the process innovation practice, it emits fewer carbon footprints and reduces the waste amount, which decreases the cost of handling waste and increases firm performance. Burki et al. (2019) propose that when a company tries to innovate its process and managerial ways, it increases its financial performance due to the shift in the sector, which takes the firm away from competition and creates a new market for it.

Conferring the study by Lakovou et al. (2016), 75% of American firms agreed that their economic performance was increased by recognizing green process innovations. Green process innovations encourage firms to use green raw materials, eliminate waste, reduce carbon emission, and increase sustainable practices (Wong et al., 2020; Achi et al., 2022). Going green means innovating ordinary manufacturing processes into greener processes, which results in environmentally friendly products (Huang and Chen, 2022). Because of adopting green process innovation, manufacturing costs decrease because it uses fewer resources of firms, such as energy consumption, which increases firm financial performance (Burki et al., 2019). DCV clarifies the connections among sustainability and performance of the firms, where researchers explained that adopting green innovations provides the firm with various dynamic capabilities such as smooth manufacturing, innovative processes, environmental management, a decline in environmental waste, decrease in cost, and offers a competitive advantage, which in turn increases firm performance (Burki et al., 2018; Wong et al., 2020). Although researchers have attempted to illustrate the relationship between green innovations and the firm's performance, their core focus was on measuring operational, environmental, customer, and economic performance using survey data, which is not as transparent as secondary data. Researchers like (Burki et al., 2019; Wong et al., 2020; Afum et al., 2020) suggest green innovations positively influence a firm's economic performance. Hence, the following hypotheses are proposed:

H4 *Green managerial innovations have a positive relationship with the firm's financial performance*

H5 *Green process innovations have a positive relationship with the firm's financial performance*

3. Methods

3.1. Sample selection and data collection

To accomplish research goals, we selected manufacturing companies complying with sustainable practices and standards, such as ISO 14,000/14,001, Pakistan Standard & Quality Control Authority (PSQCA), and National Policy for Solid Waste Management (NPSWM). We targeted supply chain managers, production mangers, procurement management, and logistics managers. Through continuous efforts and follow-ups, we managed to collect 325 questionnaires out of 404. This study's response rate is outstanding and is way above the threshold response rate of 20%, as suggested by Malhotra and Grover (1998). The reason behind this extraordinary response was the regular follow-ups with the respondents. The questionnaire was discussed with the respondents during the first visit, and ample time was given to return the response. Later, follow-up calls were made to request the response submission. The second visit was made to collect the questionnaire and submit a note of thanks for their time. Out of 325 questionnaires received, 12 were incomplete; multiple answers were observed for 4, resulting in 309 usable responses. At the second stage, we collected the financial statement data for the responded companies, out of which data of financial statements for 13 companies were unavailable. Thus, our final sample size consists of 296 observations which include automobile (6%), textile (35%), cement (5%), chemical (7%), electric goods (1.6%), engineering (4.7%), fertilisers (2%), paper and board (2.3%), technology and communication (3.3%), pharmaceutical (2.7%), food and personal care (6.4%), sugar and allied (7.4%), tobacco (1%), Vanaspati (1%), transport and logistics (1%), leather and tanneries (1.7%), synthetic and rayon (2.7%), and glass and ceramics (2.3%). Table 1 represents the sampling profile such as industry, size, age, and respondent's profile.

Table 1
Sampling profile.

Industry	N (%)
Automobile	06 (16%)
Textile	103 (35%)
Cement	15 (5%)
Chemical	23 (7.7%)
Electric Goods	05 (1.6%)
Engineering	14 (4.7%)
Fertilisers	06 (2%)
Paper and Board	07 (2.3%)
Technology and Communication	10 (3.3%)
Sugar and Allied	22 (7.4%)
Tobacco	04 (1.3%)
Vanaspati	03 (1.1%)
Transport and Logistics	03 (1.1%)
Leather and Tanneries	05 (1.7%)
Synthetic and Rayon	08 (2.7%)
Glass and Ceramics	07 (2.3%)
No. of Employees	
<100	43 (15%)
101–500	65 (22%)
501–1000	80 (27%)
1001–5000	78 (26%)
>5000	30 (10%)
Age of Firm	
1–10	65 (22%)
11–19	158 (53%)
>19	73 (25%)
Respondent	
Manager Supply Chain	87 (29%)
Assistant Manager Supply Chain	112 (38%)
Procurement Manager	49 (17%)
Production Manager	48 (16%)
Status in Supply Chain	
Parent Company	141 (48%)
First Tier Supplier	58 (20%)
Second Tier Supplier	24 (8%)
Wholesaler	41 (14%)
Retailer	32 (10%)
Total (%)	***296 (100%)***

3.2. Instruments for data collection

All the items were adopted from the previous literature and adjusted to the context of this study. Sustainable supply chain integration is measured through three constructs internal, supplier, and customer integration. Sustainable internal integration is measured through seven items based on the previous literature (e.g., Wu, 2013; Syed et al., 2019). Sustainable supply integration is measured through five items based on previous literature (e.g., Demeter et al., 2016; Wu, 2013; Syed et al., 2019). Sustainable customer integration is measured through five items constructed from the literature (Wu, 2013; Afshan and Motwani, 2018; Syed et al., 2019). Green managerial innovations are measured through five items based on the previous literature (Chen et al., 2018; Burki et al., 2019; Xie et al., 2019). Green process innovations are measured through three items based on the previous literature (Wu, 2013; Burki et al., 2019; Xie et al., 2019). This study use two accounting measures, return on assets (ROA) and return on equity (ROE), to estimate firm financial performance. ROA tells about "how much a firm is efficient in terms of generating profits from its applied resources" (Mahajan and Singh, 2013). ROE tells about "firms' efficiency in generating profits from shareholders' investments" (Lau and Sholihin, 2005). We have used the following formulae to calculate ROA and ROE:

$$ROA = \frac{Profit\ After\ Tax}{Total\ Assets} \tag{1}$$

$$ROE = \frac{Profit\ After\ Tax}{Shareholder's\ Equity} \tag{2}$$

The questionnaire was developed based on the above-discussed sources. To judge the suitability of the questions for achieving the study's objectives, we consulted with a panel of five supply chain practitioners and academicians. Initially, we generated a seven-point Likert scale questionnaire, but upon panel suggestions, the questionnaire was converted into a 9-point Likert scale to provide more variety to the respondents. The validity and reliability of a 9-point scale questionnaire are more effective than scales lower and higher than 9-point scales (Alwin and Krosnick, 1991). Table 2 presents the sources of the constructs used in this study.

3.3. Methods used for analysis

Employing the structural equational modeling (SEM) technique, this study used SPSS 25 and AMOS 26 software to analyze the relationship among constructs. SEM in AMOS is considered an appropriate technique where the sample size is large enough. It can detect the unobserved heterogeneities in the sample, which helps to check the robustness of the results. The results are carried out in two phases. First, the reliability and validity are checked through the exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). Second, the relationships among various constructs are analysed using the SEM technique.

4. Results

4.1. Reliability and convergent validity

To check the reliability of the constructs, Cronbach's alpha was calculated. The Cronbach's alpha results are 0.83, 0.92, 0.95, 0.95, 0.95, and 0.75, respectively, which are larger than the threshold value of 0.60 suggested by Lee et al. (2007). Convergent validity is checked by performing exploratory factor analysis in which validity is checked using factor loadings (FL) and composite reliability (CR). Convergent validity describes the degree to which distinct indicators within the same structure are correlated (Cheung and Wang, 2017). The received FL is between 0.52 and 0.98, and the level of significance is < 0.001. Thus, the results of EFA suggest the existence of convergent validity in our research model. Harrington (2008) stated that "high factor loading suggests factors are convergent on the same point, which shows high convergent validity." Correspondingly, composite reliability (CR) is calculated through the "sum of squared factor loadings and then dividing them by the sum of squared factor loadings plus the sum of errors extracted" (Syed et al., 2019). CRs are calculated to tell whether consistency exists in constructs or not? The obtained CRs for the factors are 0.87, 0.91, 0.95, 0.94, 0.95, and 0.71. The obtained CRs are larger than 0.60, a threshold value determined by Kline (2010) and Lee et al. (2007).

Average Variance Extracted (AVE) talks about how distinct the first construct is from the second. The obtained AVEs of the constructs in the study are 0.56, 0.74, 0.83, 0.73, 0.86, and 0.58. All AVEs are larger than 0.50, a cutoff figure determined by Fornell and Larker (1981) and Kline (2010). Secondly, confirmatory factor analysis (CFA) was performed employing AMOS 26 to check validity. We check the fit indices for the isolated model of the study, and it shows the data decently fit with the model. SRMRs of all factors are either equal or less than 0.03, showing a decent model fit Wu (2013). The fit indices for six-factor are $\chi^2/\text{df} = 1.231$,

Table 2
Sources of constructs.

Constructs	Statement	Sources
Sustainable Internal Integration	**SII1:** Our firm has established environmental management system **SII2:** Environmental practices are followed by the management of our firm **SII3:** Environmental problems are communicated in various departments of the organization **SII4:** To comply with environmental practices audit system is applied in our organization **SII5:** Our firm shares a proper knowledge management system to comply with environmental issues **SII6:** Cross-cultural cooperation is supported throughout our firm supply chain to enhance environmental practices **SII7:** Our firm works in teams including (marketing, production, and distribution) to launch green products	Wu, 2013; Syed et al., 2019
Sustainable Supply Integration	**SSI1:** To accomplish sustainable supply chain goals, our company cooperate with its suppliers **SSI2:** Required specifications of products designs are provided to the suppliers to comply with specifications **SSI3:** An audit system is implemented to check the environmental practice's adherence of suppliers **SSI4:** Our firm motivates its suppliers to opt for environmental certification provided by ISO and local regulatory bodies **SSI5:** Suppliers are carefully chosen after evaluating their implementation status of environmental practices	Demeter et al., 2016; Wu, 2013; Syed et al., 2019
Sustainable Customer Integration	**SCUI1:** To achieve environmental objectives jointly, our firm integrates with customers **SCUI2:** To diminish the negative effects of products on the natural environment, our firm involves customers in the production process **SCUI3:** To offer green design of the products, our firm invites customers to participate actively **SCUI4:** Customers such as retailers and wholesalers are invited to take part in sustainable packaging and distribution **SCUI5:** Customers are invited to take part in cleaner production and environmental practices	Wu, 2013; Afshan and Motwani, 2018; Syed et al., 2019
Green Managerial Innovation	**GMI1:** Our firm's management supports redesigning the production process to meet environmental criteria **GMI2:** Our firm's management supports in redesigning operation processes to meet environmental criteria **GMI3:** Our firm's management supports redesigning new and existing products to meet environmental criteria **GMI4:** Our firm's management supports in designing recyclable products to meet environmental criteria **GMI5:** Our firm's management is committed to using eco-labeling	Chen et al., 2018; Burki et al., 2019; Xie et al., 2019
Green Process Innovation	**GPI1:** Our firm is engaged in processes that reduce the emission of hazardous material **GPI2:** Our firm is engaged in processes that reduce consumption of electricity, water, gas, and petroleum **GPI3:** Our firm is engaged in processes that recycle, reuse, and reproduce material and decrease the use of raw material	Wu, 2013; Burki et al., 2019; Xie et al., 2019
Firm Financial Performance	**FFP1:** Return on Assets **FFP2:** Return on Equity	Mahajan and Singh, 2013 Lau and Sholihin, 2005

Table 3
Reliability and convergent validity.

Constructs	Items	Factor Loadings	Cronbach's Alpha	Composite Reliability	Average Variance Extracted	SRMR
Sustainable Internal Integration	SII2	0.844	0.830	0.871	0.562	0.018
	SII3	0.692				
	SII4	0.673				
	SII6	0.730				
Sustainable Supply Integration	SSI1	0.849	0.910	0.913	0.742	0.003
	SSI2	0.828				
	SSI4	0.884				
	SSI5	0.872				
Sustainable Customer Integration	SCUI1	0.901	0.950	0.952	0.830	0.015
	SCUI2	0.927				
	SCUI4	0.921				
Green Managerial Innovation	GMI1	0.910	0.952	0.940	0.730	0.014
	GMI2	0.896				
	GMI3	0.943				
	GMI4	0.885				
Green Process Innovation	GPI1	0.987	0.955	0.951	0.860	0.001
	GPI2	0.851				
	GPI3	0.976				
Firm Financial Performance	FFP1	0.953	0.751	0.710	0.580	0.000
	FFP2	0.521				
Statistics Summary						
χ^2/df = 1.231 CFI = 0.992 TLI = 0.991 IFI = 0.993 NFI = 0.962 RFI = 0.962, GFI = 0.937 RMSEA = 0.028						

Table 4
Fornell larcker criterion.

	SII	SSI	SCIN	GMI	GPI	FFP
Sustainable Internal Integration	***0.750***					
Sustainable Supply Integration	0.370	***0.861***				
Sustainable Customer Integration	0.128	0.046	***0.911***			
Green Managerial Innovation	0.533	0.618	0.107	***0.854***		
Green Process Innovation	0.407	0.434	0.118	0.615	***0.927***	
Firm Financial Performance	0.068	0.092	0.018	0.129	−0.069	***0.761***

Note: The values in diagonal have been obtained by taking the square roots of the AVE of each construct.
SII = Sustainable Internal Integration, SSI = Sustainable Supply Integration, SCIN = Sustainable Customer Integration, GMI = Green Managerial Innovation, GPI = Green Process Innovation, FFP = Firm Financial Performance.

IFI = 0.993, NFI = 0.962, CFI = 0.992, TLI = 0.991, RFI = 0.962, GFI = 0.937 and RMSEA = 0.028. The results presented in Table 3 suggest good reliability and convergent validity.

4.2. Discriminant validity

Discriminant validity is defined as "the extent to which variables differ empirically" (Hair et al., 2014). To verify the discriminant validity in the study, three approaches were adopted, square root of AVEs, Heterotrait-Monotrait ratio (HTMT), and survey items relevance using item loadings and cross-loadings (Fornell and Larcker 1981; Cheung and Wang, 2017). Table 4 presents the instrument's determination validity by providing the links between constructs and the square root of AVE, most commonly known as the Fornell-Larcker criterion. The diagonal values suggest that the square root of AVE is greater than the correlation coefficient between the variables. The findings indicate no discriminant validity problem.

Cross-loading is an excellent criterion to determine discriminant validity (Fornell and Larcker 1981). According to the literature, "each entry's load should be greater than the burden of the succeeding construct, and the entry load is also regarded as a threshold" (DiStefano et al., 2018). Table 5 presents the item loadings and cross-loadings of the constructs, demonstrating that factor item loads are more significant than other potential factors. The results in Table 5 sufficiently satisfy the cross-loading criterion.

HTMT is also considered a decent indicator for identifying the discriminant validity (Fornell and Larcker 1981). If the obtained values are less than 0.90 in HTMT results, discriminant validity has been established between the constructs. The highest value in Table 6 is 0.657, which is less than the threshold value. Hence, according to the HTMT criterion, discriminant validity has been established in this study.

Table 5
Cross loading criterion.

	SII	SSI	SCIN	GMI	GPI	FFP
SII2	**0.879**	0.068	0.025	0.245	0.006	0.014
SII3	**0.728**	0.170	0.021	0.103	0.040	−0.078
SII4	**0.733**	0.078	0.002	0.036	0.179	0.005
SII7	**0.652**	0.046	0.038	0.135	0.000	0.008
SSI1	0.002	**0.851**	−0.027	0.066	0.010	0.012
SSI2	0.003	**0.884**	−0.006	0.041	0.033	−0.024
SSI4	0.033	**0.861**	−0.011	0.116	0.023	0.002
SSI5	0.081	**0.880**	0.038	0.089	0.051	0.014
SCIN1	−0.010	−0.047	**0.918**	0.010	0.041	−0.022
SCIN2	−0.011	−0.022	**0.913**	0.021	0.008	−0.004
SCIN4	0.015	−0.003	**0.932**	0.055	−0.014	−0.011
GMI1	0.032	0.045	0.014	**0.894**	0.032	0.007
GMI2	0.053	0.012	0.004	**0.900**	0.033	0.022
GMI3	0.055	0.011	0.007	**0.901**	0.020	0.023
GMI4	0.024	0.025	0.006	**0.930**	0.014	0.031
GPI1	0.032	0.010	0.001	0.010	**0.970**	0.013
GPI2	0.034	0.023	0.015	0.171	**0.829**	0.028
GPI3	0.016	0.001	0.011	0.044	**0.992**	0.008
FFP1	0.019	0.035	0.007	0.099	0.028	**0.972**
FFP2	0.048	0.017	−0.017	0.099	−0.071	**0.709**

SII = Sustainable Internal Integration, SSI = Sustainable Supply Integration, SCIN = Sustainable Customer Integration, GMI = Green Managerial Innovation, GPI = Green Process Innovation, FFP = Firm Financial Performance.

Table 6
Heterotrait-monotrait ratio (HTMT) criterion.

	SII	SSI	SCIN	GMI	GPI
Sustainable Supply Integration	0.436				
Sustainable Customer Integration	0.144	0.055			
Green Managerial Innovation	0.607	0.657	0.106		
Green Process Innovation	0.458	0.457	0.119	0.631	
Firm Financial Performance	0.101	0.111	0.040	0.154	0.087

SII = Sustainable Internal Integration, SSI = Sustainable Supply Integration, SCIN = Sustainable Customer Integration, GMI = Green Managerial Innovation, GPI = Green Process Innovation, FFP = Firm Financial Performance.

Table 7
Variance inflation factor (VIF).

Construct	Items			
Sustainable Internal Integration	SII2 (**1.483**)	SII3 (**1.544**)	SII4 (**1.591**)	SII7 (**1.603**)
Sustainable Supply Integration	SSI1 (**2.889**)	SSI2 (**2.747**)	SSI4 (**2.646**)	SSI5 (**2.984**)
Sustainable Customer Integration	SCIN1 (**2.294**)	SCIN2 (**2.104**)	SCIN4 (**2.170**)	––
Green Managerial Innovation	GMI1 (**3.060**)	GMI2 (**3.586**)	GMI3 (**3.611**)	GMI4 (**3.501**)
Green Process Innovation	GPI1 (**2.754**)	GPI2 (**2.628**)	GPI3 (**2.989**)	––
Firm Financial Performance	FFP1 (**1.315**)	FFP2 (**1.327**)	––	––

SII = Sustainable Internal Integration, SSI = Sustainable Supply Integration, SCIN = Sustainable Customer Integration, GMI = Green Managerial Innovation, GPI = Green Process Innovation, FFP = Firm Financial Performance.

4.3. Common method bias and multicollinearity

This study applied Harman's one-factor test to check whether the problem of common method bias (CMB) exists or not. The test results showed that factors with eigenvalues greater than one show 71% of the total variance. The first factors comprise 23% of the total variance extracted, smaller than the threshold limit of 50%, suggested by Wong et al. (2011). Furthermore, to check the multicollinearity issue, we calculated the variance inflation factor (VIF), and all the items of the constructs show VIF less than 5 presented in Table 7. Hence, no issue of multicollinearity among the constructs was found.

4.4. Results of the hypothesized model

For analysis purpose we employed AMOS 26 to analyze the data. The model fit indices were checked first to identify the credibility of the hypothesised results. Values of model fit indices (χ^2/df = 1.126, NFI = 0.965, RFI = 0.957, CFI = 0.996, TLI = 0.995, IFI = 0.996, GFI = 0.947 and RMSEA = 0.021) show a decent model fit. Value of $\chi 2$/df = 1.126 is less than 2.00, which is considered as cut-off value and was recommended by Kline (2010); CFI = 0.996, TLI = 0.995 and NFI = 0.965 are larger than threshold value 0.900 described by Former and Larker (1981); RMSEA = 0.021 is less than 0.080, a cut off value (Kline, 2010; Chen et al., 2018).

After analysing the model fit indices, the relationships among constructs are checked and presented in Fig. 2 and Table 8. The first two hypotheses measure the influence of sustainable internal integration on green innovation. Results ($\beta = 0.413$, $p = 0.000$) of H1a display that sustainable internal integration is positively related to green managerial innovation. H1b exhibits that sustainable internal integration is positively related to green process innovation ($\beta = 0.321$, $p = 0.000$). Hypotheses H2a and H2b identify how sustainable supply integration practices affect green innovation. Results ($\beta = 0.485$, $p = 0.000$) of H2a display that sustainable supply integration is positively associated with green managerial innovation. Comparably, sustainable supply integration is also positively associated with green managerial innovation. H2b displays that sustainable supply integration is positively related to green process innovation ($\beta = 0.307$, $p = 0.000$). Hypotheses H3a and H3b check the effects of sustainable customer integration on green innovation. Results ($\beta = 0.073$, $p = 0.086$) of H3a display that sustainable customer integration is positively associated to green managerial innovation. H3b represents that sustainable customer integration is positively associated with green process innovation but is statistically insignificant ($\beta = 0.003$, $p = 0.176$).

Table 8
Summary of the hypothesized results.

Hypotheses	Standardized Path Coefficient	Results
H1a: Sustainable internal integration => Green managerial innovation	0.413***	Supported
H1b: Sustainable internal integration => Green process innovation	0.321***	Supported
H2a: Sustainable supply integration => Green managerial innovation	0.485***	Supported
H2b: Sustainable supply integration => Green process innovation	0.307***	Supported
H3a: Sustainable customer integration => Green managerial innovation	0.073*	Supported
H3b: Sustainable customer integration => Green process innovation	0.003	Not-Supported
H4: Green managerial innovation => Firm financial performance	0.155**	Supported
H5: Green process innovation => Firm financial performance	−0.084*	Supported
χ^2/df = 1.126 CFI = 0.996 TLI = 0.995 IFI = 0.996 NFI = 0.965 RFI = 0.957 GFI = 0.947 RMSEA = 0.021		

Note:.
*** $p < 0.001$,.
** $p <$ 0 0.05,.
* $p < 0.10$.

H4 measures the impact of green managerial innovation on firm financial performance. The H4 ($\beta = 0.155$, $p = 0.003$) exhibit that green managerial innovations are positively associated with FFP. Nevertheless, results of H5 ($\beta = -0.084$, $p = 0.061$) which measures the impact of green process innovation on firm performance, reject the hypothesis. GPI has a negative relationship with firm financial performance, showing that green process innovation increases the firm's costs and decrease the firm's financial performance.

The maximum likelihood (ML) method was adopted to calculate indirect and total effects. Table 9 presents the results of direct, indirect, and total effects. The indirect effects of sustainable internal integration through green managerial innovation and green process innovations on firm financial performance is 0.063. The indirect ef-

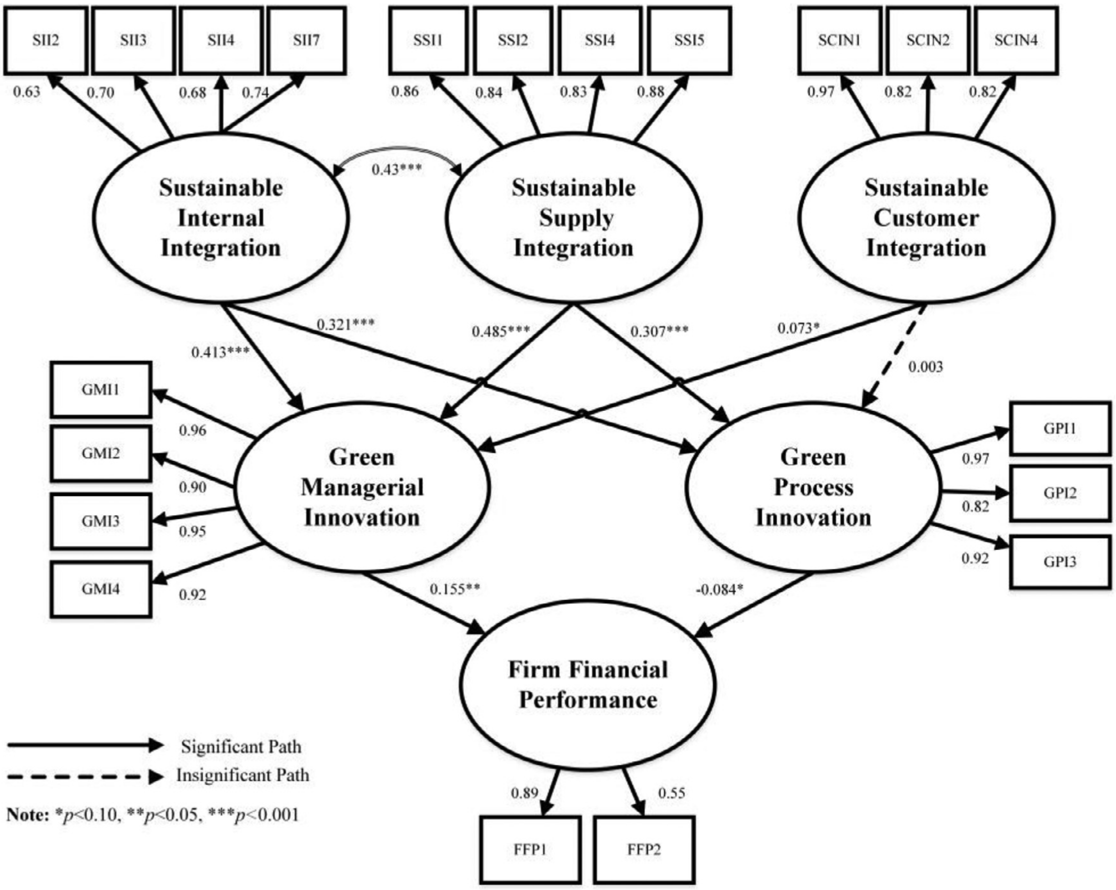

Fig. 2. Hypothesized model results.

Table 9
Direct, indirect and total effects.

Variable	SII			SSI			SCUI			GMI			GPI		
	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE	DE	IE	TE
GMI	0.413		0.413	0.485		0.485	0.073		0.073						
GPI	0.321		0.321	0.307		0.307	0.003		0.003						
FFP		0.063	0.063		0.074	0.074		0.011		0.155		0.155	−0.084		−0.084

SII = Sustainable Internal Integration, SSI = Sustainable Supply Integration, SCIN = Sustainable Customer Integration, GMI = Green Managerial Innovation, GPI = Green Process Innovation, FFP = Firm Financial Performance.

fects of sustainable supply integration through green managerial innovation and green process innovation on a firms' financial performance is 0.074. The indirect effects of sustainable supply integration through green managerial innovations, and green process innovations on a firms' financial performance is 0.011.

5. Discussion

Environmental concerns in business are increasing as governments, customers, and public agencies are more concerned about the environment than ever before, which needs firms to integrate their strategies and supply chains with respect to environmental concerns. This study contributes to the SSCI and SSCM literature by investigating the association between SSCI, GI, and FFP.

Results reveal that sustainable supply chain integration fosters firm green innovations, which increases a firm's financial performance. Three integration types of SII, SSI, and SCI have shown a positive relationship with green managerial innovations (GMI) and green process innovations (GPI), except for the relationship between sustainable customer integration and green process innovation. Customer integration might help more on product specifications rather than process innovation. Research findings strengthen the results of prior studies (Chen et al., 2018; Wong et al., 2020) that manufacturers' innovation abilities are enhanced when they collaborate with partners in their supply chains and work together towards joint environmental goals. Moreover, apart from external integration, the study explores that internal integration performs a vigorous role towards green innovations, which was ignored in prior studies and has been examined by few researchers (Wu, 2013; Aisjah and Prabandari, 2021). Our research supports the information processing theory view, which emphasises that collaborating and sharing inter and intra-organisational resources increases firms' supply chain visibility and helps take decisions quickly (Wong et al., 2020). Furthermore, it also supports the dynamic capability view, as green innovation is a capability that reduces water use, helps firms decrease emissions, reduces cost, and increases firm performance.

Moreover, our findings coincide with the results of prior studies and suggest that when a firm integrates its resources inside and outside with all supply chain partners and stakeholders, it tends to have better innovation opportunities (Xie et al., 2019; Wong et al., 2020; Aisjah and Prabandari, 2021). Furthermore, our findings demonstrate that green managerial innovations are positively related to FFP, which suggests that when management is concerned about new ideas and supports GI, it positively impacts performance. The result is consistent with the results of prior studies (Burki et al., 2019; Wong et al., 2020). Alternatively, green process innovation is negatively significantly related to the firm financial performance. This suggests that rapid change in processes due to pressure from environmental bodies, regularity authorities, and government pressure increases firms' costs and results in lower profits and decreased performance. This result contradicts the findings of prior studies (e.g., Xie et al., 2019; Aisjah and Prabandari, 2021; Achi et al., 2022).

5.1. Theoretical contributions

This research contributes to the SSCM in multiple ways. First, it has developed a theoretical, conceptual model including the construct of SSCI, GI, and FFP, in contrast to prior studies (Wu, 2013; Burki et al., 2019; Wong et al., 2020) that have ignored the combined effects of these constructs. Thus, the contributions of this research are valuable as it provides both theoretical and empirical evidence of links between SSCI and green innovations and firm financial performance. Second, this study confirms the information processing theory view (Wong et al., 2020) through the results of a theoretical model showing that sustainable internal, supply, and customer integration have a positive influence on green innovations. Third, this study incorporates green managerial innovations, a complex and ignored area in the green supply chain. Prior researchers have ignored it in their studies while examining the relationship of SCI with green innovations. Our findings indicate that three observed types of supply chain integration are significantly positively associated with green managerial innovations. Fourth, green process innovation might come at the expense of lowering a firm's financial performance for the short term. In the long run, the firm might benefit from such green process improvement and innovation. Finally, this study has provided real insight into a firms' financial performance by examining it directly through financial data statements, which researchers in the prior studies have ignored.

5.2. Practical implications for managers and policymakers

This study provides useful implications for managers accountable for a firm's day-to-day operations regarding sustainable supply chain issues. The outcomes of this work show that when firms cooperate, share knowledge, and work jointly with all players in the supply chain, it tends to innovate their process, techniques, and ways of doing business. Thus, the managers should be mindful of the environmental facets of the products in the early development phase and focus on internal integration while focusing on external (supplier and customer) integration. Green process innovation might lower a firm's financial performance in the short run while improving a firm's performance in the long run. Hence managers should be ready to endure the short-term financial loss for environmental improvement and innovation.

Firms should not just focus on process innovation; instead, they should also proceed with managerial innovations such as top management commitment regarding different phases of process development. Furthermore, it is suggested that managers encourage their supply chain partners to take environmental certifications to meet the compatibility of environmental regulations. The study indicates a positive relationship between green managerial innovations to firm financial performance. This study suggests that policymakers should think about revising the environmental policy in the country as small to medium firms are noted as operating at a loss, and their observed sustainability practices are quite low. To motivate these firms to adhere to environmental policy guidelines, policymakers must eradicate barriers in implementing SSCI and green innovation processes, which is possible through establishing an environmental practice learning program, financing research and development activities, and motivating customers and supply chain partners to collaborate.

6. Conclusions

Although the previous literature has tried to explain the concept of SSCI, GI, and firm performance, they have treated them separately. This study has combined the three concepts to measure their impact by using both primary and secondary data. Furthermore, the findings are based on an emerging Pakistan economy with different cultural and operational peculiarities from the western point of view prevalent in the existing literature.

Though this study contributes to existing literature, theory, and practices, some limitations could open new research directions for future research. First, this study only accounted for firms listed on the Pakistan Stock Exchange and ignored unlisted firms. Thus research, including non-listed firms, has the potential of providing new insights. Second, the oil and gas sector was discarded from this study due to the secrecy of information sharing by the companies. Including the oil and gas sector can provide a real insight into the upcoming studies. Third, we have taken only green managerial and green process innovation in our study; including other variables of green innovations in future studies could describe different perspectives. Finally, this study has measured FFP through accounting-based measures, and taking market-based measures as determinants of firm financial performance could provide more insight into a firms' market performance.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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